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ABSTRACT

The phenomenon of pain is still very puzzling. It is not a purely physical phenomenon. Overwhelming research evidence suggests various psychological variables affecting the pain experience. The purpose of this paper is to present an overview of some promising cognitive-behavioral approaches to the control of pain. Anxiety clearly plays a role in attenuating or intensifying the subjective experience of discomfort. However, the exact nature of the role played by anxiety and how best to influence it are unknown. Nonspecific factors such as e ectation, suggestion, and other so-called "placebo" effects can greatly influence pain. Cognitive variables such as distraction, imagery manipulation, and modeling influences are also therapeutically productive. Their superiority over nonspecific influences has not been demonstrated, however. Relaxation and biofeedback techniques may offer some answers to problems involving specific types of pain, but a comprehensive approach stressing self-control skills seems to be the direction to take in future pain research. (Author)

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Coping with Pain: A Review of Cognitive-Behavioral Interventions

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Coping with Pain: A Review of Cognitive-Behavioral Interventions

Pain is not a purely physical phenomenon. Overwhelming research evidence suggests various psychological variables affecting the pain experience (Melzack and Wall, 1965). For example, treatment strategies manipulating cognitive activities such as expectancy, direction of attention, and perception of control have proved highly successful in modifying pain perception (Weisenberg, 1977). Along with this increasing recognition of the efficacy of psychological approaches to the management of pain has come the realization that psychologists and counselors must take responsibility for the refinement and implementation of strategies appropriate to their clientele (Espin and Ganikos, 1975). The counseling profession must work along with other professions to develop an interdisciplinary approach to the treatment and management of pain (Melzack, 1973; Steinbach, 1968, 1974). The purpose of this paper, then, is to present an overview of some promising cognitive-behavioral approaches to the control of pain.

Current Status

Before proceeding to descriptions of treatment a brief discussion of several theories of pain and methodological problems in pain treatment research is in order. Specificity theory treats pain as a separate sensation. Simply stated, pain receptors transmit sensory information via a pain pathway to a pain center in the brain (Weisenberg, 1975). A psychological component is acknowledged which is directly linked to a specific physical stimulus. Proponents of pattern theories oppose the notion of pain as a separate sensory modality. Pain is seen as a result

of stimulus intensity and the summation of sensory input (Melzack, 1973). Lastly, according to affect theories pain is an emotion, not a sensation (Melzack, 1973). Actually this is the oldest approach to the problem of pain, predating conceptions of pain as a sensory modality. Aristotle viewed pain in opposition to pleasure (Melzack, 1973).

Melzack and Wall's (1965) gate control theory of pain attempts to integrate the useful aspects of the preceding theories. Whether or not this approach is conceptually accurate, gate control theory has important treatment implications. Three components of the pain experience are proposed: sensory-discriminative, motivational-affective, and cognitive-evaluative. Interacting in a complex manner, these three components serve to explain such puzzling phenomena as phantom-limb pain, psychogenic pain, and the neuralgias (Melzack, 1973). More importantly, the theory points the way to further refinement of approaches to pain therapy through the manipulating of motivational and cognitive processes.

Beecher (1956), for example, demonstrated that the amount of pain experienced is not related to the amount of tissue damage. In his comparison of wounded soldiers and civilian surgical patients, the amount of pain reported was influenced more by patient attitudes towards the wound than to the severity of the injury. Cognitive variables may also underlie the effectiveness of placebos. It has long been recognized that the expectation of improvement generally results in some decrease in pain perception without the presence of an "active" therapeutic agent. Evans (1974) reports that drug placebos alone produce an improvement of at least half of what is produced by pharmacological means in responsive individuals. Beecher (1959) reviewed a number of clinical studies finding that reductions in pain occurred with approximately 35% of all

patients receiving placebos. These findings are particularly noteworthy in light of the fact that extensive investigations into this phenomenon are actually only at an initial stage.

In developing treatment approaches various types of pain have come under investigation. Although the ultimate goal is to decrease clinical pain, analogs are commonly used to increase experimental control. Electric shock is especially popular because it is a discrete stimulus, easily controllable, and can be increased or decreased in measured intervals (Tursky, Watson, and O'Connell, 1965). Other common pain-inducing stimuli include immersion of an extremity in ice water (Blitz and Dinnerstein, 1968; Kunkle, 1949; Wolf and Hardy, 1941), radiant heat (Hardy, Wolf, and Goodell, 1952), gross pressure (Merskey and Spear, 1964; Ryan and Kovacic, 1966), and ischemia (Williams, 1959; Williams, Williams, and Kartchner, 1965). Since these measures produce different types of pain, studies utilizing different stimuli may report conflicting results. For example, Davidson and McDougall (1969) discovered a lack of generalizability on tolerance measures between the cold pressor, pressure algometer, electric shock and radiant heat pain stimulators.

Beecher (1959) has argued that experimentally induced pain is qualitatively different than pain experienced in a clinical setting. The essential difference is the much higher degree of anxiety associated with clinical pain. A major result is that experimentally produced discomfort does not respond to morphine and other drugs as reliably as pathological pain (Beecher, 1966). There even appears to be a difference between acute and chronic pain states in a clinical setting (Steinbach, 1975). Lastly, the temporal qualities of a pain stimulus affect the results of treatment studies. Often pain is induced so rapidly a subject

does not have time to employ an intervention effectively (Meichenbaum and Turk, 1976). Beecher (1966) suggests the submaximum effort tourniquet technique (Smith, Egbert, Markowitz, Mosteller, and Beecher, 1966; Smith, Lewenstein, Hubbard, and Beecher, 1968) as the solution. The ischemic pain produced by this procedure responds differentially to morphine and a placebo. While it is questionable whether the assessment problem in pain research is really "solved," efforts to use pain stimuli more closely approximating pain in a clinical setting are necessary and heuristic. Each assessment procedure serves a purpose, depending on the nature of the experiment. While not approximating clinical pain in terms of responsiveness to morphine, other procedures may resemble "real" pain in other ways.

The dependent measures used also vary widely from study to study and affect the interpretation of results. Subjective reports of the amount of pain experienced do not necessarily correlate with pain threshold, the length of time between the initial exposure to a stimulus and the point at which pain is felt, or pain tolerance, the total amount of time the stimulus is withstood (Beecher, 1957). Gelfand, Ullman, and Krasner (1963) used still another measure, the pain sensitivity range or pain duration. This is defined as the difference between threshold and tolerance. While these are the measures most commonly used, other methods abound (Weisenberg, 1977).

Beecher (1959) has distinguished between physiological and psychological influences on pain perception. Threshold is seen as being primarily influenced by physiological factors while tolerance is more amenable to psychological control. If this theory is true, there should be little change in reported pain thresholds after treatment interventions.

There does not seem to be any clear answer to this controversy. Clark and Bindra (1956) found pain thresholds on three different stimuli more variable than tolerance scores and suggested that attitudinal variables played a large part in producing these differences. However, in a recent review Steinbach (1975) supported Beecher's contention of pain thresholds being controlled by sensory processes.

Meichenbaum and Turk (1976) discuss some other variables which could potentially confound comparisons between studies. Evidently pre-exposure to the painful stressor may sensitize subjects by decreasing the anxiety experienced on the post-test. Furthermore, experimenter-subject sex effects may play a role in differential treatment effectiveness. The same applies to the subject's perceived control over the stressor, experimental instructions and demand, and the spontaneous use of coping strategies. For an extended discussion of the problems and pitfalls of pain assessment see Beecher (1957) or Weisenberg (1977).

Manipulation of Cognitive Variables

Placebo Effects

As stated previously, placebo analgesia can be very effective in reducing pain perception. In fact, the effects are so pronounced that Evans (1974) has suggested that the placebo should be viewed as an effective therapeutic agent. However, questions regarding why placebo analgesics work and how best to enhance their effects remain unanswered.

Anxiety reduction is the most commonly used explanation for the decreased pain perception resulting from placebo treatments. It is fairly clear that the presence of anxiety is related to pain sensitivity, but an increase in pain tolerance due to anxiety reduction has not been

conclusively demonstrated (Shor, 1962). It may be that reduction of chronic, but not situational anxiety states, produces lowered pain perception (Evans, 1974). A problem with investigations of this kind is that often experimental manipulations do not produce enough anxiety to allow room for studying its reduction (Shor, 1962). In general, placebos have been more effective in relieving pathologically produced pain (Beecher, 1956).

Gelfand, Ullman, and Krasner (1963) agree that anxiety reduction accounts for a part of placebo effectiveness, but that other psychological factors are also important. For example, an increased sense of control over a painful stressor can enhance pain tolerance (Bowers, 1968; Geer, Davison, and Gatchell, 1970; Staub, Tursky, and Schwartz, 1971). It is not yet clear, however, whether increased predictability, anxiety reduction, or a complex interaction of these factors with situational variables is the major "cause" of the associated decrease in pain perception (Averill, 1973). Information and preparation about the upcoming aversive situation has also been shown to reduce distress (Johnson, 1973; Johnson and Leventhal, 1974) and increase pain tolerance (Neufeld and Davidson, 1971). The importance of individual difference dimensions has been emphasized by other researchers (Davidson and Bobey, 1970; Davidson and McDougall, 1969; Johnson, Leventhal, and Dabbs, 1971; Morgan, Lezard, Prytulak, and Hilgard, 1970; Ryan and Foster, 1967).

Research demonstrates that what has been labeled "the placebo effect" can be viewed in terms of various social influence factors which alone, or in combination with decreased anxiety, serve to enhance pain tolerance. However, pain measures are still under voluntary control. Are increases in reported or tolerated pain due to a decrease in pain

sensitivity or an increasing reluctance to acknowledge pain? Feather, Chapman, and Fisher (1972) reported that a decrease in pain perception as a result of a placebo drug was due to almost entirely attitudinal influences. According to Melzack and Wall (1965), however, cognitive variables are a very "real" part of the pain experience. The attempt to divide interacting influences into two separate effects may be misleading.

Instructions, Suggestions, Attention/Distraction

Instructions or suggestions may also produce analgesia in responsive subjects. While hypnotists are commonly known to employ suggestion as a therapeutic technique, it is not so widely known that the power of suggestion in the waking state rivals hypnotic suggestion (Evans and Paul, 1970). Suggestibility is not related to the placebo effect, nor is it solely dependent on expectancy or situational variables (Evans, 1967). Furthermore, McGlaskin, Evans, and Orne (1969) have demonstrated that hypnotic analgesia is composed of two separate components: effects due to nonspecific factors and some other, separate influences. If, as Evans and Paul (1970) contend, hypnosis is no different than other forms of behavioral influence, a study of that second component should lead to more direct applications of the active variables.

Wolff, Krasnegor, and Farr (1965) and Wolff and Horland (1967), using cutaneous electrical stimulation, compared the effects of permissive and non-permissive instructions on pain threshold, tolerance, and sensitivity range. The permissive trials involved no urgings to increase tolerance. The non-permissive trials followed the no-instruction trials, with subjects receiving instructions to imagine that they would receive $1000 for every second they waited before ending the pain stimulation. The

tolerance and sensitivity measures were greatly increased by the non-permissive instructions while threshold was not.

Blitz and Dinnerstein (1968) investigated the effects of suggestive instructions on pain threshold and tolerance. The noxious stimulus employed was electric shock. The three groups received different sets of instructions. A control group was asked to report their detection threshold, pain threshold, the point at which they would ask for drug relief, and their "quit point." No motivating instructions were given. The second group received instructions designed to elevate the pain threshold. The third group of subjects were instructed in a manner similar to the experimental subjects in the Wolff and Horland (1967) study. The results indicated that the instructions differentially affected the pain measures; the group receiving threshold instructions scored highest on the pain threshold and drug request measures, while the pain quit point was elevated for both threshold and tolerance instruction groups. These results run counter to the findings of Wolff, et al. (1965) and suggest that motivational influences modify both threshold and tolerance measures. The discrepancy could be explained by the specificity of the instructions in the present investigation.

Blitz and Dinnerstein (1971) studied the role of self-distraction via differing types of dissociation produced by instructions. Group 1 was instructed to focus on cold rather than pain while undergoing the cold pressor task. Group 2 was instructed to reinterpret the cool sensation as pleasant, while the third group served as a control. Both experimental groups were found to have significantly elevated pain threshold, but not pain tolerance.

It is not clear what role instructions alone play in these studies. Is the cognitive strategy supposedly employed of prime importance or are the experimenter's instructions causing change? Perhaps an even more crucial question concerns the strategy actually used by the subjects. Regardless of the ultimate answers to these and other questions, instructions do play an important role in influencing pain processes.

Kanfer and Goldfoot (1966) demonstrated that diverting attention away from a noxious stimulus enhances pain tolerance. A no treatment control was compared to four other groups: subjects in the first group were told to expect severe pain; those in the second group were instructed to verbalize their experiences; subjects in the third group used a clock to set goals for tolerance; while subjects in the last group viewed travel slides. The clock and slide conditions were significantly more effective as measured by pain tolerance on the cold pressor task.

In a related investigation into the effects of distraction, Kanfer and Seidner (1973) found that subjects who could control the rate of slide presentation displayed greater ice water tolerance than subjects viewing slides controlled by the experimenter. Both slide groups exhibited greater pain tolerance than a yoked control group. A second study reported in the same paper indicated that pain tolerance could be increased by means of contingent reinforcement of coping strategies. A strategies plus reinforcement group achieved higher tolerance scores than strategies-only or reinforcement-only groups.

Melzack, Weisz, and Sprague (1963) studied the effectiveness of audio analgesia, a distractor which at one time received a great deal of attention (Melzack, 1973). Auditory stimulation combined with strong

suggestion proved superior on cold pressor tolerance scores. Neither distraction nor suggestion alone produced significant increases in tolerance.

Walker (1971) failed to find increased tolerance to electric shock as a result of a distraction strategy. A test of neuromuscular skill requiring a good deal of concentration served as the distractor. While it was a very different type of strategy than those employed in the previous studies, it evidently did serve to divert attention away from the pain. The nature of the painful stressor may account for the differences. Ice water produces a more slowly rising pain curve than electrical stimulation.

Barber and Cooper (1972) compared three distraction techniques with a no treatment control. The two strategies which involved more concentration on the part of the subject, listening to a story and adding aloud, produced a significant decrease in self-reported discomfort. The pain stimulus used, the Forgione-Barber pressure device, produced painful pressure on the index finger. Subjects were required to tolerate this for two minutes and were then asked to report on the intensity of the pain experience. The significant results applied only to the first minute of stimulation; no differences existed for the second minute. This discrepancy may be due to the nature of the assessment strategy and the pain measure used. Control subjects also reported using their own distraction methods.

Imagery/Distraction

While studying the phenomenon of hypnosis, Barber and Hahn (1962) found that subjects instructed to imagine ice water stimulation as

pleasant reported a discomfort level of the same magnitude as subjects receiving hypnotic analgesia. Supporters of hypnosis have challenged these results (Hilgard, 1973). Irrespective of the controversy concerning hypnosis, subjects employing imagery did report less pain than two control groups.

Greene and Reyher (1972) compared three hypnotic conditions: analgesia, pleasant imagery, and analgesia plus pleasant imagery. Hypnotic analgesia was superior to both pleasant imagery and the combined treatment in increasing subjects' tolerance to electric shock. Greene and Reyher (1972) hypothesized that the imagery used could have interfered with analgesia. Subjects were free to choose their own scenes and many focused on sensuous bodily sensations that might have been counterproductive. The rapid use in discomfort produced by electric shock may also have contributed to the conflicting results.

Grimm and Kanfer (1976) also reported on an imagery-distraction strategy. Cold pressor discomfort was measured via tolerance, heart rate, and self-reported pain intensity. Tolerance scores for the imagery group increased significantly more than the relaxation, expectancy, and no treatment control groups. Heart rate decreased significantly for the relaxation condition but this was unrelated to pain reduction.

Lazarus and Abramovitz (1962) introduced emotive imagery as an alternative to systematic desensitization. Images designed to generate positive feelings are substituted for deep muscle relaxation. Horan (1973, 1975) applied this procedure to real life aversive stimulation, terming it "in vivo" emotive imagery. Horan and Dellinger (1974) reported that subjects who listened to relaxation-producing images tolerated ice water significantly longer than those exposed to no treatment

or distraction conditions. The distraction control subjects were instructed to count backwards from 1000. These results tend to support the thesis that imagery strategies may be more than mere distraction. Perhaps the generation of positive emotions actively inhibits pain perception.

Horan, Layng, and Pursell (1976) compared in vivo emotive imagery, neutral imagery, and no imagery in a within subjects design. Dental patients undergoing routine tooth prophylaxis reported a significant decrease in pain perception due to the relaxation imagery. The neutral imagery condition, which could be considered a form of distraction, produced greater decreases than the no treatment condition. Heart rate differences did not appear. One problem encountered was that the supposed relaxation-producing images did not have the expected effect on all subjects.

Westcott and Horan (in press) demonstrated that anger, relaxation, and neutral imagery conditions produced increases in cold pressor tolerance, but were not significantly different than a no treatment control. The non-significant results were evidently due to insufficient power rather than inadequate treatments.

Finally, Stone, Demchik-Stone, and Horan (1977) reported results supporting the efficacy of in vivo emotive imagery. Subjects receiving training in producing relaxing imagery tolerated the cold pressor task significantly longer than those asked to focus on one point or subjects receiving no imagery training. Relaxation-producing breathing exercises did not significantly affect pain perception or tolerance.

It is safe to conclude from the preceding studies that attention distraction procedures are effective in increasing pain tolerance and

decreasing subjective discomfort. The relative efficacy of the various procedures subsumed under this heading is unclear, as are the reasons why the procedures are effective.

Beers and Karoly (1976) compared four distraction and imagery conditions with no treatment and expectancy placebo controls. Compatible imagery and task-relevant rational thinking proved superior on ice water threshold and tolerance measures. Irrelevant distraction also produced significantly greater threshold scores than the control groups. However, subjects engaging in imagery incompatible with the pain stimulus displayed no greater tolerance than the control subjects. Selective inattention to noxious stimulation appears to be more useful than complete distraction.

Chaves and Doney (1976) suggest two primary reasons for the effectiveness of cognitive strategies in pain reduction: (1) simple distraction and (2) instrumental relevance of the strategy employed, eg., imagery-produced relaxation inhibiting anxiety. In an investigation of these and other influences on pain tolerance, Chaves and Doney report that strategy relevance is not an important consideration. Two cognitive strategies, one instrumentally relevant and the other irrelevant to pain reduction, were both effective in reducing reported pain in comparison to a control group. However, the distraction conditions were not different from each other. Also in this study, control subjects reported using their own strategies.

It would be interesting to see the results of the Chaves and Doney study replicated using a more powerful "instrumentally relevant" technique such as in vivo emotive imagery. In the present study subjects were instructed to imagine their hand as numb. Subjects in the

"irrelevant" condition were asked to imagine that their stimulated hand had been painted with black and white stripes. Since it was not used as a dependent measure, it is unclear how pain tolerance would be affected by these manipulations.

Modeling

The effects of observational learning on numerous behaviors are well documented (Bandura, 1969). Since pain threshold, tolerance, and reported pain intensity are behaviors, it should follow that they would be subject to modeling influences. This was confirmed by Craig and Weiss (1971, 1972). Subjects exposed to highly tolerant models showed greatly increased pain thresholds in comparison to control subjects. Models demonstrating intolerance to electric shock produced significantly decreased thresholds in exposed subjects. Craig and Weiss (1971) feel that complex physiological, psychological, and social cues were operating. Modeling influences were seen as analogous to the analgesic effects of suggestion, hypnosis, and placebos.

In a related study, Craig and Neidermayer (1974) observed that subjects influenced to accept very high levels of shock experienced no more distress than subjects receiving much lower levels.

No differences in self-reported pain occurred, though thresholds varied between groups. The subjects observing a highly tolerant model demonstrated significantly higher pain threshold scores than subjects observing no model, a neutral model or a model intolerant to pain.

Craig and Coren (1975) investigated the extent to which verbal responses, rather than pain sensitivity, are affected by modeling. Again, subjects exposed to tolerant and intolerant models were compared

to no exposure subjects. Tolerance to electric shock was differentially affected by the modeling conditions. The intolerant group showed an increased sensitivity to shock that matched their verbal reports. The tolerant group showed no comparable decrease though their willingness to report discomfort was modified. The technique used by Craig and Coren to separate sensory sensitivity from response biases involves psychophysiological procedures based on signal detection theory.

While the previous studies investigated the effects of modeling on the report of pain, Chaves and Barber (1974) took a different tact. Four treatment groups were compared: pleasant imagery, imaginary insensitivity, expectancy of pain reduction, and no treatment control. Half of the subjects in each group observed the experimenter model the procedure while undergoing a pressure pain stimulus; the other half simply received instructions. The modeling procedure was ineffective except with one segment of the pleasant imagery subjects, those with high levels of reported pain on the pretest. Both cognitive strategies were superior to the control groups.

Relaxation

Since increased anxiety has been associated with increased pain perception, a decrease in that arousal should hypothetically decrease pain perception. Various procedures have been used to achieve a generalized state of relaxation including hypnosis (Hilgard, Cooper, Lenox, Morgan, and Voevodsky, 1967), deep muscle relaxation (Jacobson, 1938), and breathing exercises (Mulcahy and Janz, 1973).

Folkins, Lawson, Opton, and Lazarus (1968), in a component analysis of systematic desensitization, found that either relaxation training or cognitive rehearsal alone were as effective in reducing stress reactions as the combined procedure. Relaxation training was seen as an effective therapeutic strategy in its own right.

Lehrer (1972) utilized electric shock to compare the pain thresholds and reported pain intensity of four groups in an analog of desensitization. One group received relaxation training, one was a no treatment control, and the other two groups received instructions to tense their muscles or simply be aware of the muscle tension experienced. The relaxation and control groups habituated to the shocks much more quickly than the remaining two groups, indicating a lower level of anxiety. The question arises as to why the subjects receiving relaxation training did not exhibit less anxiety than the control group. A possibility could be that anxiety levels were so low to begin with that it was impossible to produce further decrements. However, pain thresholds were not differentially affected and there were no significant differences in reported pain intensity. It appears that the ability to cope with pain was not influenced by this intervention, and there is a good possibility that relaxation was not really enhanced because of the brevity of the training.

In another attempt to look at the separate effects of relaxation training, Bobey and Davidson (1970) compared four groups using radiant heat and the pressure algometer. Relaxation training was compared with (1) cognitive rehearsal consisting of a detailed description of procedures, (2) an anxiety condition: listening to a tape of women undergoing childbirth, and (3) a control group listening to a boring tape of study habits. On both pain stimulation procedures the subjects receiving

relaxation had the highest tolerance scores. No significant differences occurred among the other groups for the pressure test, but differential results did occur for tolerance scores on the radiant heat test. The "anxiety" and cognitive rehearsal groups exhibited significantly higher tolerance scores than the control subjects.

Davidson and Neufeld (1974) obtained results supporting Bobey and Davidson's (1970) conclusion that relaxation should be superior to cognitive strategies in the relief of pain. Subjects were exposed to a pain stressor, a film designed to arouse psychological stress, and a control condition. Frontalis muscle tension and respiration rate, two physiological responses reduced by relaxation, were shown to differentiate the pain and psychological stress conditions. It was hypothesized that cognitive manipulations would enhance coping responses with subjective stress, while relaxation training would be more useful in dealing with aversive stimulation.

McAmmond, Davidson, and Kovitz (1971) found relaxation and hypnosis to be equally effective in increasing pain tolerance for highly aroused subjects. Other researchers have also argued for the usefulness of hypnosis in producing relaxation in hypnotizable subjects (Hilgard, et al., 1967). Evans and Paul (1970) observed that subjects receiving waking relaxation and hypnotic analgesia suggestions reported significantly less discomfort than the same groups without suggestions. Evidently, in order for relaxation to be effective in reducing pain, subjects must be told that the discomfort should decrease.

An extensive range of clinical pain problems have been treated with relaxation strategies. Tasto and Hinkle (1973) treated tension headaches with deep muscle relaxation and reported a dramatic decline in the number

of headaches experienced. Lutker (1971) employed relaxation training in the treatment of migraine headaches. Even phantom limb pain has been shown to improve as a result of relaxation exercises (McKechnie, 1975).

Relaxation can be induced through a variety of techniques. Stewart (1976) recommends simple breathing exercises as an easy and effective means of reducing tension. These methods have also been advocated by proponents of drug-free childbirth (Bing, 1967); Wright, 1968). In an experimental investigation, Mulcahy and Janz (1973) found that subjects trained in breathing exercises demonstrated significantly higher pain thresholds than control subjects.

Beary and Benson (1974) reported several factors common to all relaxation methods. Transcendental meditation is used as an example. Necessary elements include a mental device, a passive attitude, decreased muscle tonus, and a quiet environment. Perhaps less emphasis should be placed on procedures per se, and more emphasis placed on the achievement of these correlates of a relaxed state.

Biofeedback

Biofeedback is a generic term for a wide range of techniques designed to increase voluntary control of physiological responses (Schwartz, 1975). Biofeedback procedures were originally applied to pain control in an effort to enhance relaxation. The treatment of muscle tension headache through electromyograph (EMG) feedback is a straight forward application to "real life" pain problems (Budzynski and Stoyva, 1969; Greene, Walters, Green, and Murphy, 1969). Ironically, though tension reducing strategies appear promising in treating "tension" headaches, there is no hard data to support the commonly held belief

that these headaches are in fact caused by excessive muscle contraction (Bakal, 1975).

Budzynski, Stoyva, and Adler (1970) demonstrated a decrease in headache activity for subjects receiving EMG feedback for tension headaches. Furthermore, Budzynski, Stoyva, Adler, and Mulloney (1973) reported that an EMG feedback group experienced significantly fewer headaches than pseudo feedback or no treatment control groups. This decreased headache activity was highly correlated with lower EMG levels. Three out of six subjects in a study conducted by Epstein and Abel (1977) reported significantly reduced headache intensity levels of EMG activity were not related to improvement in this case. Cox, Freundlich, and Meyer (1975) found relaxation training to be as effective as EMG biofeedback in reducing tension headache frequency, intensity, and duration.

Hendler, Derogatis, Avella, and Long (1977) employed EMG biofeedback treatment with patients suffering from various types of chronic pain. Although eleven of the thirteen patients could not alter their muscle tension as a result of biofeedback, six did report significantly decreased pain levels. Hendler, et al. also conclude that the results are greater than what would be expected as a result of placebo influences.

Migraine headaches are different than tension headaches in etiology and symptomatology (Bakal, 1975). It would therefore seem likely that treatment approaches to this problem might also differ. Sargent, Green, and Walters (1973) demonstrated that "autogenic feedback training" was effective in treating twelve of fifteen migraine sufferers. This procedure consists of a simultaneous management of mental and somatic functions. Passive concentration on relaxing words and phrases (autogenic training) is combined with training to increase hand temperature. This

is accomplished by temperature feedback to increase vaso dilation of the blood vessels in the extremities. Migraine headaches are caused by vaso-dilation of the extra cranial arteries. Relief is usually induced by pharmacological methods to construct the extra cranial arteries (Bakal, 1975). Obviously, regulation of the blood flow to the extremities must affect cranial blood flow as well. The usefulness of this method for the treatment of muscle tension headache is unclear.

Wickramaskera (1973) treated two migraine sufferers with "temperature training." The procedure was the same as that employed by Sargent et al. (1973), but without the autogenic training component of passive mental concentration. Interestingly, Wickramaskera's subjects had previously been treated with EMG feedback without success.

Boudewyns (1976) studied a finger temperature feedback procedure under varied conditions. Finger temperature was found to decrease as a result of stress and increase as a result of relaxation. Johnson and Turin (1975) reported a striking covariation between finger temperature and migraine activity. Friar and Beatty (1976) employed a feedback procedure to directly induce vaso constriction of the extra cranial arteries. Those subjects treated by this method experienced significantly fewer headaches than either a no treatment control group or a group trained in vaso constriction of the blood vessels in the hand.

Gannon and Steinbach (1971) used alpha electroencephalogram (EEG) feedback to reduce the headache pain experienced by a patient who had suffered extensive head injuries. This was suggested by observational studies indicating a relationship between the high levels of alpha wave activity produced by individuals in the meditative state and an increased pain tolerance. Gannon and Steinbach's patient reported being able to

prevent the onset of headaches by going into a high alpha state.

Melzack and Perry (1975) compared alpha feedback, hypnosis, and a combined treatment for patients with chronic pain. The combined treatment condition produced significant decrements in reported pain. Neither procedure was effective alone. Melzack and Perry reasoned that the efficacy of alpha feedback was due to distraction of attention, suggestion, relaxation, and an increased sense of control. Cox et al. (1975) outlined several reasons for the successfulness of EMG biofeedback: the reduction of muscle tension, an increasingly relaxed lifestyle, early recognition of the onset of pain, or early application of relaxation skills. There are undoubtedly elements of truth in both views.

Holmes and Frost (1976) used a false feedback technique to decrease the perceived intensity of electric shock. Reported anxiety was also decreased, but indices of physiological arousal did not change. These results need to be investigated further.

Comprehensive Approaches

Norton and Nielson (1977) point out that, while biofeedback and relaxation may decrease pain behaviors, they do not increase "well behaviors." Perhaps we would achieve superior results by replacing maladaptive behaviors with more appropriate behaviors. This is a much more important consideration when dealing with chronic pain. Chronicity provides opportunities for pain to come under the influence of the same laws of learning governing any other behavior (Fordyce, 1976).

A multi-faceted approach to the problem of long-standing pain was employed by Fordyce and his colleagues (Fordyce, 1973; Fordyce, Fowler, Lehmann, and DeLateur, 1968) in a hospital setting. Medications were

administered on a time contingency schedule. Previously, patients had received analgesics on demand, thus reinforcing pain behaviors. Social reinforcement was eliminated for expressions of discomfort. Appropriate reinforcers were identified for each of the three rehabilitation patients. Reinforcement was then contingently administered for increased activity, meeting occupational therapy quotas, and participation in off-ward activities. Fordyce et al. (1968) reported a significant decrease in pain behaviors as well as increases in behaviors incompatible with pain for all participants. Fordyce, Fowler, Lehmann, DeLateur, Sand, and Trieschmann (1973) demonstrated similar results with a much larger group of subjects. It is important to note that patients voluntarily agreed to participate in these programs, were aware of the contingencies, and expressed a great deal of satisfaction with the results.

Egbert, Battit, Welch, and Bartlett (1961) attempted to reduce post-operative pain in 97 surgical patients. Those receiving "special care" in the form of encouragement and information about the upcoming operation were compared to a no treatment control group. Special care patients made significantly fewer requests for narcotics after surgery. In a related study, Cohen and Lazarus (1973) failed to show that patients' coping disposition, anxiety, or life stress were significantly related to recovery.

Langer, Janis, and Wolfer (1975) attempted to reduce patient stress by supplying information about surgical procedures ("emotional inoculation") or training subjects in calming self-talk and other cognitive strategies ("coping device"). Patients receiving the coping device requested significantly fewer pain relievers and sedatives. Emotional inoculation alone was not superior to a no treatment control.

A more refined procedure was employed by Levendusky and Pankratz (1975) in an attempt at non-pharmacological analgesia. In this case study relaxation training, covert imagery, and cognitive relabeling were used to enable a patient to be completely withdrawn from medication. Success was suggested to be a function of self-attributed behavior change. The self-control techniques enhanced the subject's perception of internal control, thus increasing pain tolerance (Bowers, 1968; Geer, Davison, and Gatchel, 1970).

In a hospital setting, a pain patient's environment can be carefully monitored and systematically influenced. Very different treatment interventions are necessary for dealing with other types of clients. Cautela (1977) suggests a covert conditioning treatment package for problems of pain. Thought stopping and relaxation training would provide subjects with strategies for effective distraction. Pleasant imagery and covert operant manipulations would also be useful. Cautela presents case study data to illustrate the successful application of these techniques.

Mitchell and Mitchell (1971) present a comprehensive approach to the control of migraines. The reduction of migraine headaches is viewed in terms of an increased ability to control emotional reactivity. In the first study reported, a combined desensitization program is shown to be more effective than either an applied relaxation or no treatment group. The combined desensitization program includes systematic desensitization, applied relaxation, and assertive therapy. In a second study, combined desensitization was more effective than systematic desensitization plus relaxation in reducing the frequency and duration of migraine episodes.

Mitchell (1971) also reports on the effectiveness of a comprehensive treatment program. The intensity and frequency of migraine attacks decreased substantially as a result of an intervention including systematic desensitization, assertive therapy, and re-educative training.

Mitchell and White (1977) expanded the earlier conceptions of appropriate interventions for migraine sufferers. Subjects were equipped with self-control skills to enable them to actively intervene early in the behavioral sequence leading up to the migraine attack. Self-recording of migraines, self-monitoring of stressful events, physical and mental relaxation, and thirteen self-change techniques were taught to subjects. Through a sequential dismantling analysis, Mitchell and White determined that each procedure added to the total package. Thus it would seem that multiple-component treatments for pain may be superior to single method interventions.

Meichenbaum and Truk (1976) present evidence for the efficacy of a comprehensive coping skills program labeled "stress-inoculation." Not only are various strategies taught, but subjects are given an opportunity to practice these strategies. The package contains three components: education, coping skills training, and practice. Using Melzack's (1973) conceptual framework as a basis, Meichenbaum and Turk proposed different treatment strategies to influence the three psychological components of pain. For the sensory discriminative aspect, relaxation training is employed. Imagery and distraction procedures should affect the motivational affective component, and self-instructional training (Meichenbaum, 1977) is used to affect cognitive-evaluative processes. Stress-inoculation training proved to be very effective in increasing ischemic pain tolerance.

One of the most unusual aspects of this treatment procedure is the emphasis on choice. A whole range of techniques is offered and subjects are urged to choose "cafeteria style" those which would be most effective for them. Previous research has indicated that subjects usually exhibit controlling responses to aversive stimulation whether they are instructed to or not and usually have definite preferences as to which strategies they want to use (Chaves and Barber, 1974; Chaves and Doney, 1976).

Horan, Hackett, Buchanon, Stone, and Demonik-Stone (1977) analyzed the three major components of the stress inoculation package: education, coping skills, and practice. The procedure varied slightly from the Meichenbaum and Turk (1976) formulation. In the practice component subjects were exposed to a real stressor, the cold pressor task, rather than imaginally rehearsing the techniques. The entire package was found superior to the separate components and a no treatment control on cold pressor tolerance, threshold, and subjective discomfort. Generalization to a pressure pain stimulus did not occur. The comparative efficacy of in vivo and imaginal exposure was unclear.

In an effort to sort out the contributions of actual pain exposure to the stress inoculation package, Hackett, Horan, Buchanon, and Zumoff (1978) compared three groups. Horan et al. (1977) had asked subjects in the exposure group to endure the ice water task a total of six times during treatment. Hackett et al. (1978) compared subjects receiving six exposures with subjects receiving no and one exposure. The one exposure condition resulted in superior tolerance on both the cold pressor and pressure algometer tasks. It appears that some exposure to noxious stimulation enhances pain coping but overexposure diminishes gains back to the point of no exposure. This is in keeping with the concept of

"inoculation": a mildly stressing experience enhancing the refinement of skills that will later be useful in dealing with a more aversive situation.

Single-shot approaches to the alleviation of pain have a united usefulness (Weisenberg, 1977). Multi-component packages clearly show promise (Meichenbaum and Turk, 1976; Mitchell and White, 1977). However, much more research is necessary to expand and refine present methods and develop effective new procedures.

Summary

The phenomena of pain is still very puzzling (Hilgard, 1969). Anxiety clearly plays a role in attenuating or intensifying the subjective experience of discomfort. However, the exact nature of this role played by anxiety and how best to influence it is unknown. Nonspecific factors such as expectation, suggestion, and other so-called "placebo" effects can greatly influer pain. Cognitive variables such as distraction, imagery manipulation, and modeling influences are also therapeutically productive. Their superiority over nonspecific influences has not been demonstrated, however. Relaxation and biofeedback techniques may offer some answers to problems involving specific types of pain, but a comprehensive approach stressing self-control skills seems to be the direction to take in future pain research.

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